

Application Number: 10/728,609
Amendment Date: January 14, 2009
Reply to Office Action of: February 16, 2007

Remarks

A. Response to Examiner Observation

The Examiner observed that claims 1, 3, 9, 10, 24, 26, 32 and 33 recite the limitation “optional” or “optionally” and noted that the limitations recited after the word “optional” or “optionally” have not been further treated on the merits because “optional” is an act of choice. The word “optional” or “optionally” has been removed from Claims 1, 3, 9, 10, 24, 26, 32 and 33 as currently amended. Consideration of claims 1, 3, 9, 10, 24, 26, 32 and 33 on the merits is requested.

B. Response to Rejections

Owing to the characteristics of panoramic images, any method, process or apparatus designed to facilitate the creation of panoramic image-based virtual tours or virtual reality environments is generally compelled to incorporate essential units such as the panoramic image data acquisition unit, a transform unit for required coordinate and format transformations and a distortion correction unit for the correction of perspective and other types of distortions. Consequently, such components are not unique to any specific virtual tour system but are generally required for the proper functioning of all such systems. However, the manner in which distortion correction is accomplished in a given system determines the level of expertise required to utilize the system and thus plays a critical role in defining the usefulness and range of applicability of the system. Furthermore, virtual tours are more realistic when they provide a means of navigating more than one environment map in a manner akin to the way one usually navigates the real world. So-called “hotspots” are used in a wide variety of virtual tour systems to facilitate the navigation of a plurality of environment maps, each of which typically represents a panoramic field of view.

The Examiner rejected claims 1-3, 7-8, 10, 18-19, 22, 24-26, 30-31, 33, 41-42 and 45 under 35 U.S.C. § 102(b) as being anticipated by Henley, U.S. 5,657,073. As amended, claims 1-3, 7-8, 10, 18-19, 22, 24-26, 30-31, 33, 41-42 and 45 are no longer anticipated by Henley. Henley teaches (see claim 1, U.S. 5,657,073) an imaging system for the production of a panoramic or a panospheric output image for the simultaneous seamless merging of a plurality of overlapping input images to collectively display an entire field of panoramic view wherein a plurality of cameras are mounted so as to collectively

Application Number: 10/728,609
Amendment Date: January 14, 2009
Reply to Office Action of: February 16, 2007

capture said panoramic field of view. The system of Henley is limited to the capture of a single environment map – referred to as an “entire panoramic field of view” in Henley. The phrase “representing a plurality of environment maps” has been added to claims 1 and 24 to further clarify the characteristics of the panoramic data in the present invention. As currently amended, the present invention is directed towards a system for creating, managing and publishing interactive virtual tours or virtual reality systems that utilize a plurality of environment maps, each of which could represent an “entire panoramic field of view”. The use of multiple environment maps brings greater realism to the system and permits a level of interactivity not attainable with the system of Henley which is limited to one environment map or entire panoramic field of view. In FIG. 9 of the drawings, the plurality of environment maps is represented in 3-dimensional space by preview elements labeled P.sub.1, P.sub.2, P.sub.3, . . . , P.sub.n that can be used to select the associated environment map, each of which represents an entire panoramic field of view. FIG. 10 of the drawings also illustrates the use of a plurality of environment maps but shows the preview elements in a 2-dimensional configuration.

Additionally, according to the principles of the present invention, general-purpose distortion correction can be carried out in an automatic or visual and interactive manner – dramatically lowering the level of expertise required for successful operation and significantly expanding the range of applications of the system since a wider variety of distortion profiles and their associated panoramic imaging systems can be supported while obviating the need for extensive user training. This is one of the features that distinguishes the present invention from the prior art.

Claims 2, 3, 7-8, 10, 18-19, 22 depend on claim 1 and combine the distinctive features of the present invention outlined in claim 1 with their respective features. In combination with the unique and significantly useful features disclosed in claim 1, claims 2, 3, 7-8, 10, 18-19, 22 offer clear advantages over the prior art. Claim 24 is a method claim corresponding to apparatus claim 1 and delineates the features – including the distortion correction algorithm -- that distinguish the present invention from the prior art. Similarly, claims 25, 26, 30-31, 33, 41-42 and 45 ultimately depend on, and serve to further limit and clarify, claim 24 which, as already demonstrated, is patentable over the prior art.

Application Number: 10/728,609
Amendment Date: January 14, 2009
Reply to Office Action of: February 16, 2007

The Examiner rejected claims 4, 5, 27 and 28 under 35 U.S.C. § 103(a) as being unpatentable over Henley, U.S. 5,657,073, in view of Tanida, U.S. 7,009,652. Although Tanida teaches a well-known video camera comprising a multiplicity of photosensitive elements arrayed on a spherical surface, and responsive to electromagnetic radiation, nowhere does Tanida teach the distortion correction method introduced by the present invention. The correction of distortions (both predictable perspective distortion and other less predictable types of distortion) is a critical step in panoramic imaging and virtual reality systems such as those encountered in the field to which the present invention pertains. Accordingly, claims 4, 5, 27 and 28 as amended are non-obvious and thus patentable over Henley, in view of Tanida.

The Examiner rejected claims 6 and 29 under 35 U.S.C. § 103(a) as being unpatentable over Henley, U.S. 5,657,073, in view of Keast, U.S. 5,721,585. Note the foregoing discussion of Henley and Tanida. Keast discloses an image system that provides both a 180-degree vertical field of view and a 360-degree azimuthal view but fails to address the distortion correction required for the incorporation of the image system in a virtual reality system. Consequently, claims 6 and 29 as amended are non-obvious and thus patentable over Henley, in view of Keast.

The Examiner rejected claims 9, 14-16, 20-21, 23, 32, 37-39, 43-44 and 46 under 35 U.S.C. § 103(a) as being unpatentable over Henley, U.S. 5,657,073, in view of Jackson et al., U.S. 5,990,941. Jackson teaches the delivery of the image data via broadcast, cable, digital networks such as the Internet or on transportable media. However, the combination of the distribution methods taught by Jackson with the image system disclosed by Henley in a manner that permits straightforward distortion correction as taught by the present invention clearly involves a non-obvious inventive step. Furthermore, the package generator and associated “hotspots”, navigation sequences and navigable paths, viewing and control engine taught by Jackson fail to incorporate the distortion correction algorithm disclosed by the present invention. Accordingly, claims 9, 14-16, 20-21 and 23 as amended are non-obvious and thus patentable over Henley, in view of Jackson et al. Similarly, claims 32, 37-39, 43-44 and 46 are method claims corresponding to apparatus claims 9, 14-16, 20-21 and 23 and are thus patentable over Henley, in view of Jackson et al.

Application Number: 10/728,609
Amendment Date: January 14, 2009
Reply to Office Action of: February 16, 2007

The Examiner rejected claims 11-13 and 34-36 under 35 U.S.C. § 103(a) as being unpatentable over Henley, U.S. 5,657,073, in view of Xiong, U.S. 5,960,108. Xiong teaches the capability to convert the panoramic image data from one format to another. Further, Xiong teaches a means of correcting distortions that relies on the experimental choice of a polynomial of suitable degree and is limited to a radial distortion model. Note, however, that Xiong fails to provide a visual and interactive means of selecting a suitable polynomial for any specific lens and teaches a distortion correction method that is limited to a radial distortion model, which though useful in certain situations, fails to accommodate a wide variety of panoramic imaging systems for which the radial distortion model is unsuitable. And as noted earlier, distortion correction is required for format and coordinate transformations as the impact of any errors introduced by the imaging system and/or any other sources must be minimized. Experimentally selecting the degree of the polynomial, as taught by Xiong, is a potentially tedious, offline trial-and-error process that would generally require a significant degree of expertise to accomplish successfully. The present invention overcomes the limitations of Xiong by teaching a means to visually and interactively define the distortion profile of any given lens system under the guidance of the usually immediate, real-time feedback provided by the technique of the present invention. Thus, the present invention significantly expands the range of lenses and imaging systems that can be used to generate virtual tours and dramatically lowers the threshold of expertise required to use the system successfully. Accordingly, claims 11-13 as amended are patentable over Henley, in view of Xiong. Similarly, claims 34-36 are method claims corresponding to apparatus claims 11-13 and are thus patentable over Henley, in view of Xiong.

The Examiner rejected claims 17 and 40 under 35 U.S.C. § 103(a) as being unpatentable over Henley, U.S. 5,657,073, in view of Smith, U.S. 6,226,658. Although Smith discloses a so-called “universally” readable document file format, said format is limited by the requirement of compiling a target list of word processor applications into each of which the document file is to be retrieved in a corresponding target document layout, the target document layout for each word processor application on the list desired to be substantially identical to the original document layout. In contrast, the “universal” file format disclosed in the present invention is not limited to any target word processor applications but represents information as self-describing elements. While it is possible for one of ordinary skill in the art to combine the document format taught by Smith with the imaging system of Henley, the combination of the unique virtual reality system and universal file format disclosed in the present invention clearly requires a non-obvious

Application Number: 10/728,609
Amendment Date: January 14, 2009
Reply to Office Action of: February 16, 2007

inventive step and provides significant advantages (for example: greater realism from the use of a plurality of environment maps, applicability to a wider range of imaging systems and independence from a list of target word processor applications) over the combination of the universal document format of Smith and the imaging system of Henley. Accordingly, apparatus claim 17 and corresponding method claim 40 are patentable over Henley, in view of Smith.

Regarding Iwaki et al. (US 2003/0197780) and Greguss (US 4,566,763), the present invention is directed towards a system for creating and managing interactive virtual tours that permits visual and interactive correction of imaging system distortions and that supports a wider range of image sources than is possible using the system of Iwaki or Greguss.

In view of the above, it is submitted that the claims are in condition for allowance. Reconsideration of the rejections and objections is requested. Allowance of claims 1-46 at an early date is solicited.

Respectfully submitted,



Frank Edughom Ekpar.

E-mail: frank@imatronics.com

Telephone: +81-90-9767-1741